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(54) Title: IMPROVEMENTS RELATING TO PROTECTIVELY COATING ELECTRICAL EQUIPMENT			
(57) Abstract A method of applying a protective coating to an electronic panel having a multiplicity of rows of electrical connectors or other electrical components mounted thereon, characterised in that the regions of the panel between the rows of electrical connectors or other electrical components are protectively coated by means of an injection process in which coating material of accurately controlled consistency and volume is fed under pressure through a nozzle accurately located in predetermined spaced relationship with the panel surface and between rows of said connectors or other components whilst the panel and nozzle are moved at a predetermined speed and in predetermined positional relationship relative to one another.			

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IMPROVEMENTS RELATING TO PROTECTIVELY COATINGELECTRICAL EQUIPMENT

This invention relates to methods of applying protective coatings to electrical equipment for the protection of such equipment against adverse environmental conditions. More specifically the invention is directed
5 to the coating of so-called multi-layer back plane panels and other electronic panels having a multiplicity of rows of electrical connectors or other electrical components mounted thereon.

According to one known method of applying such
10 protective coatings to back plane panels on which are mounted rows of printed circuit board edge connectors the panel is dipped into a bath of coating material (e.g. HUMISEAL 1B31) after masking certain regions of the panel or components mounted thereon as required. The dipping
15 operation ensures that the panel surface including those areas between the edge connectors are adequately coated but that the depth of dipping does not cause the coating material to enter the board receiving ends of the connectors. However, it has been found that due to
20 capillary action coating material has penetrated and risen up into certain interstices of the edge connector bodies from the panel surface end of the connectors and thereby caused electrical contact problems in such connectors.

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According to the present invention the aforesaid problems due to capillary action occurring during dipping operations are avoided by protectively coating the regions of the panel between rows of electrical connectors or the like by means of an injection process in which protective coating material of accurately controlled consistency and volume is fed, preferably injected under pressure, through a nozzle accurately located in predetermined spaced relationship with the panel surface and between rows of said connectors or the like whilst the panel and injection nozzle are moved at a predetermined speed and in predetermined positional relationship relative to one another.

The accurate control of the consistency and volume of the protective material dispensed by the nozzle together with the positioning of the nozzle and the relative speed of movement between the nozzle and the panel being coated ensure that just the right amount of protective material is applied to the panel surface between the connectors or the like to allow the material to spread out and provide an adequate protective coating on the panel surface without any surplus being available to rise up through the connector bodies by capillary action as previously described.

The present invention lends itself admirably to

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computer-controlled robotic application of the protective coating material through a syringe injection nozzle carried by a movable robot arm which will be controlled so that it moves in accordance with a suitable computer
5 program relative to one or more stationary electronic panels to be coated so that the syringe nozzle moves to and fro along the channels defined between respective rows of edge connectors.

By reason of the accurate control which can be
10 exercised during the coating operation the present invention ensures high quality of the protective coatings as well as good efficiency and repeatability of the coating operation under computer controlled conditions. Computer control of the process also affords good
15 flexibility and process capability by appropriate choice of computer programs.

Other areas of the panel and/or components moulded thereon, either before or after application of protective coating material by the injection process of the present
20 invention, may be coated by spraying coating material on to these areas and/or components through a suitable spray gun.

By way of example the present invention will now be described with reference to the accompanying drawing in
25 which:

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Figure 1 shows a perspective diagrammatic view of a computer-controlled robot machine for applying protective coating material to multi-layer back plane panels; and,

5 Figure 2 is a fragmentary diagrammatic view showing an injection nozzle carried by the robot machine arm and located between adjacent rows of electrical connectors.

Referring to the drawing, the robot machine 1 includes a movable arm 2 and is located in predetermined positional relationship with a work support table 3 which
10 can be rotated through 180° in the horizontal plane, as required, for the selective positioning of multi-layer back plane panels 4 and 5 supported by the work table 3 relative to the robot arm 2.

As can be seen from Figure 2, each of the back plane
15 panels comprises rows of electrical connectors 6 between which protective coating material is required to be applied to the surface 7 of the panel. In order to apply such material so that the requisite protection is afforded without the risk of surplus coating material rising up
20 through interstices of the electrical connector bodies due to capillary action as has been the case when dipping procedures have been adopted for providing the protective coating, the present invention makes use of the robot machine 1 which is controlled by means of a computer
25 suitably programmed so that the robot arm 2 which carries

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an injection nozzle 8 moves along a path to and fro across the panel whereby the injection nozzle 8 moves along each channel in turn between adjacent rows of electrical connectors. Coating material (e.g. HUMISEAL 1B31) of accurately predetermined viscosity will be fed to the nozzle 8 from a reservoir 9 where the material is pressurised by means of a suitable inert gas (e.g. NITROGEN OR ARGON). The consistency of the coating material and the rate at which the material is dispensed by the nozzle 8 and the speed of movement of the nozzle along the channels between the connectors as well as the distance of the nozzle from the panel surface will all be accurately controlled in order to ensure high quality protective coatings.

After one of the panels (4) has been coated between connectors by the robot machine in accordance with the invention the work table 3 may be rotated automatically through 180° in order to present the other back plane panel (5) to the robot arm in readiness for coating.

After coating the second panel both panels 4 and 5 may be removed from the work table 3 and two further panels inserted in the support table in readiness for coating.

As previously mentioned other local areas of the back plane panels may be coated by spraying etc. as required before or after the panels are coated between the electrical connectors by means of the robot machine.

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CLAIMS:

1. A method of applying a protective coating to an electronic panel having a multiplicity of rows of electrical connectors or other electrical components mounted thereon, characterised in that the regions of the panel between the rows of electrical connectors or other electrical components are protectively coated by means of an injection process in which coating material of accurately controlled consistency and volume is fed under pressure through a nozzle accurately located in predetermined spaced relationship with the panel surface and between rows of said connectors or other components whilst the panel and nozzle are moved at a predetermined speed and in predetermined positional relationship relative to one another.
2. A method as claimed in claim 1, characterised in that a computer-controlled robot controls the application of the protective coating material through a syringe injection nozzle carried by a movable robot and controlled so that it moves in accordance with a computer program relative to one or more stationary electronic panels to be coated so that the syringe nozzle moves to and fro along the channels defined between respective rows of electrical components.

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3. A method as claimed in claim 1, characterised in
that selected parts and/or components mounted on the board
are coated with suitable coating material by spraying
before or after the application of the coating material to
5 the panel between the rows of electrical components.

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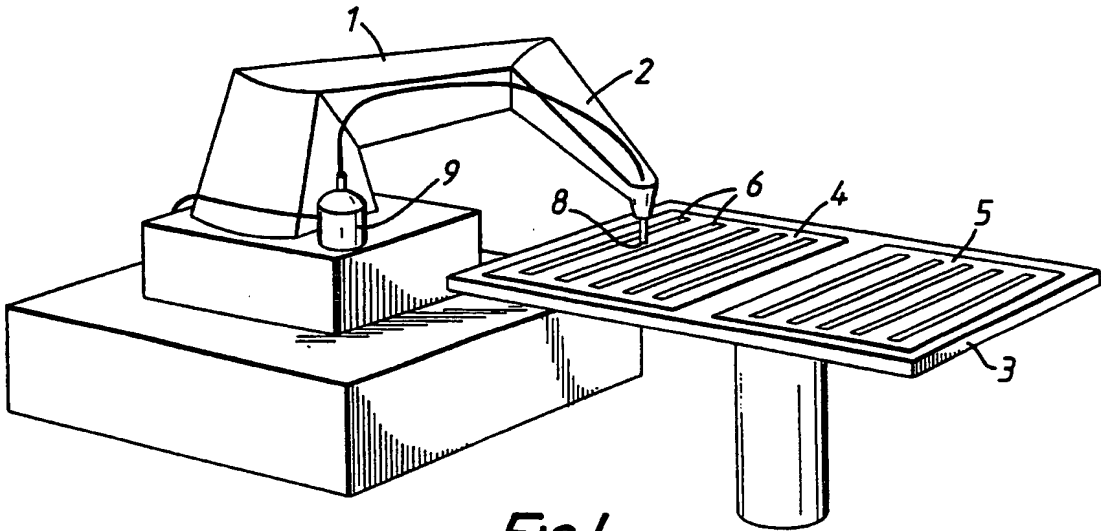


FIG.1.

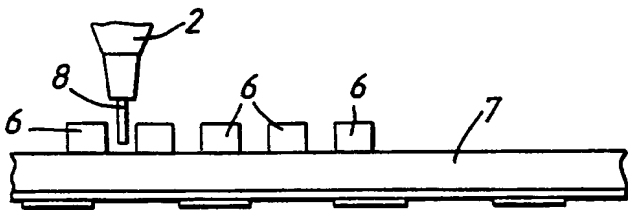


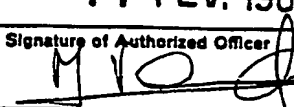
FIG.2.

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INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 85/00541

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC ⁴ : H 05 K 3/28		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC ⁴	H 05 K	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched ⁶		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁵		
Category ⁸	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	GB, A, 1403776 (COMPULINE CORP.) 20 August 1975	
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A	IBM Technical Disclosure Bulletin, volume 7, no. 11, 11 April 1965 New York (US) W.M. Howard et al.: "Pressure-Vacuum Coating Device", pages 985,986	
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A	Patents Abstracts of Japan, volume 8, no. 264, (E-282)(1701) 4 December 1984, & JP, A, 59134861 (HITACHI SEISAKUSHO K.K.) 2 August 1984	

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IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
29th January 1986	17 FEB. 1986	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE		
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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/GB 85/00541 (SA 11374)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 08/02/86

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A- 1403776	28/08/75	US-A- 3961599	08/06/76

For more details about this annex :
see Official Journal of the European Patent Office, No. 12/82